REMARKS

Attached hereto is a Request for an Extension of Time and the appropriate fee.

As the Examiner is aware, the present invention is directed to an improvement wherein a relatively high powered laser beam can be created for numerous applications such as cutting or burning holes by combining the output from a plurality of relatively low cost semiconductor lasers that are positioned within an array. The present invention specifically aligns an array of laser light oscillators so that their wavelengths can be synchronized and phase locked.

This is accomplished by providing an appropriate optical element that is aligned relative to the array so that a sufficient portion of laser beams will enter another of the plurality of the laser light oscillators to enable the phase locking of the respective laser light oscillators while passing the majority of each laser beam. In the specific embodiment disclosed on Page 22, if the reflectivity of the incidence plane is too high, the amount of laser beams that transmit through the optical element will decrease, and the ability of realizing high power output of laser light will be limited. If, however, the reflectivity of the incidence plane 21 is too low, the amount of laser beams that return to the emitting points will decrease, and the chance of them being phase locked will also be decreased. Thus, reflectivity of the incident plane is suggested to be within a range of 10% to 30% of the total laser beam.

The Office Action specifically acknowledged that the principal cited *Ota* (U.S. Patent No. 5,570,226) failed to disclose any function of phase locking its plurality of laser light amplifiers in an optical network.

Applicant has addressed a novelty description of the invention in two different approaches. With regards to Claim 1 and Claim 29, it is believed that both the *Ota* reference and the secondary references of *Craig et al.* (U.S. Patent No. 6,167,075) and *Rakuljic et al.* (U.S.

Patent No. 5,691,989) do not teach a transmission through an optical element, but rather teaches the laser beam being directing back or reflecting a sufficient portion of the laser beam.

Thus, Claim 1 (Amended) defines a diffraction grating that also transmits a laser beam from the plurality of laser light oscillators, so that it is emitted from an outlet of the diffraction grating so that a transmitted laser beam can be incident on at least one of the other laser light oscillators. Additionally, Claim 29 also defines a diffraction grating whose pitch is set to direct a sufficient portion of the laser beam to enter another of the plurality of laser beams to enable the phase locking while transmitting the remaining portion of the laser beam. It should be noted that the diffraction grating must be appropriately aligned with the respective outlets of the plurality of laser light oscillators to enable each one of the laser light oscillators to receive at least a portion of a laser beam from another of the plurality of the laser light oscillators for phase locking. It is believed that this function of alignment adds patentable weight to the phase locking claim language.

Newly drafted Claim 39 utilizes applicant's rights under 35 U.S.C. § 112, sixth paragraph, as means plus function, and, accordingly, it is believed that it more than adequately distinguishes over the cited references.

Finally, newly drafted Claim 40 also defines that the optical element will transmit a major portion of the laser beam through the optical element while at least partially directing a sufficient portion from the plurality of the laser light oscillators to enter another of the plurality of laser light oscillators to enable a phase locking.

The *Ota* reference was asserted to anticipate each of the claim elements of Claims 1, 4, 29-31, 33 and 36-37. The *Ota* is directed to an optical link amplifier to be employed in an optical communication network and, particularly, an optical link amplifier that could have a large

insertion loss with a semiconductor laser amplifier in a wavelength multiplex oscillator. As noted, semiconductor laser optical amplifiers reportedly had a disadvantage in such an optical network because they would exhibit a large coupling loss with optical fibers. See Column 3, Line 14.

A careful reading of each of the different embodiments and features of the *Ota* reference discloses that *Ota* does not attempt to phase lock an array of semiconductor laser light oscillators to produce one coherent phase locked output. Rather, the *Ota* reference wishes to deal with light sources having different wavelengths that can be mixed and still distinguished as they are distributed throughout the optical system. The *Ota* reference is more concerned with preventing interference between the respective wavelengths rather than boosting a coherent phase locked laser light output for applications wherein a laser array of a relatively economical configuration can provide a relatively high-powered laser beam.

The Office Action specifically cited the *Ota* embodiment shown in Figure 24A which is directed to a wavelength multiplex laser oscillator having an array 113 of semiconductor laser amplifiers 16. It was specifically recognized that this constituted a plurality of different wavelengths by defining it as a polychrometer system consisting of a lens 118 and a diffraction grating. The diffraction grating not only can redirect the light back through the lens to a specific array of laser amplifiers but can also direct each of the individual wavelengths to a semiconductor laser amplifier 117.

As noted in Column 17, the *Ota* invention can be applied to any type of an optical link amplifier as long as it employs an optical amplifier where the insertion loss is large. As noted in Column 20, the laser oscillations are initiated at wavelengths of 850 nm, 860 nm, and 870 nm. See Lines 20-35. These laser amplifiers 116, along with the laser amplifier 117, serve as optical

waveguides. The center and size of the radiuses of the laser beams from the respective semiconductor laser amplifiers 116X through 116Z must be selected so that they can be injected commonly into the semiconductor laser amplifier 17. Since they each have a different wavelength, and the arrangement of the diffraction grating along with the lens specifically is designed to prevent any phase locking, it is respectfully submitted that the *Ota* device is completely different from that of the present invention. It is believed that the claims as now drafted clearly define differences.

In our invention, Figures 6 through 8, an embodiment of an optical element as a diffraction grating is disclosed in front of a laser array and appropriately aligned so that it can reflect a sufficient portion of the laser beam back to the other laser light oscillators to enable the phase locking <u>while transmitting a major portion of the laser beams</u>, to thereby enable them to be combined to produce a significantly larger output power as a result of the collective emissions from each of the individual laser light oscillators.

By setting the pitch of the diffraction grating at an appropriate predetermined angle in advance and aligning it relative to the positions of the plurality of laser light oscillators, the reflected portion of the laser beam can be accurately incident on the other laser elements in the laser array to enable the phase locking. Accordingly, it is requested that the Examiner reconsider providing patentable weight to the term "phase locking".

Additionally, further advantages exist in the present invention above and beyond the enabling of a plurality of relatively cost-effective laser light oscillators to be easily synchronized and phase locked. The present invention does not require an additional waveguide, which has been conventionally required to be provided as an additional lens between the laser array and the diffractured grating.

The present invention has an advantageous characteristic that laser beams emitted from the emitting points of each of the laser elements can be linearly obtained, without an additional waveguide by virtue of the diffraction grating from a side of the diffraction grating opposite to the laser elements. Thus, the invention defined, for example, in Claims 1 and 29, permits a relatively improved but simple construction that enables laser beams emitted from the laser elements to be easily condensed to provide the desired large output.

The *Ota* reference discloses in the Figure 24A embodiment, cited by the Office Action, a technique of utilizing a reflective diffraction grating positioned to face a laser light oscillator via a lens to provide a wavelength multiplex laser system wherein the laser beams are both reflected and diffracted by the diffraction grating and returned to waveguides of a semiconductor laser light oscillator. The laser light is again reflected and diffracted by the diffraction grating and returned to a common output waveguide element 117. The diffraction grating 119 shown in Figure 24A is a reflective grating and is not designed to be a transmissive grating to pass a portion of the laser beams. In each of the other embodiments after Figure 24A, the output of the individual different wavelengths of laser light are all directed back to the laser amplifier 117 for entering into the optical fiber 109. Thus, no matter the form of the diffraction grating, they all reflect, and in some cases, condense, so that the lens can be eliminated. They do not teach a transmission of a majority of the laser light through any of these diffraction gratings.

The *Craig et al.* reference does not address the deficiencies in the principal *Ota* reference and simply teaches a redundancy in a light wave communication system to increase its reliability. Thus, a multiplicity of pumping sources is provided and driven at a level below their maximum power so if one fails, it can be compensated by the remaining pumping sources of laser diode emitters. *Craig et al.* actually teaches that the individual laser diode emitters should

have substantially no optical overlap with one another. See Column 3, Line 65, through Column 4, Line 23, and also Column 5, Lines 29-48. Thus, the *Craig et al.* reference does not address a phase locking issue, nor is it even concerned with the novel use of the diffraction grating as set forth in our claims where it is both transmissive and reflective.

The *Rakuljic et al.* (U.S. Patent No. 5,691,989) was cited for its teaching of a volume holograph grating for locking a laser output wavelength to a desired value. There is no teaching of an optical element for directing a sufficient portion of a plurality of laser beams into adjacent laser light oscillators for phase locking. Since the *Rakuljic et al.* reference does not resolve the issues missing from the *Ota* reference, any combination with *Ota* does not render obvious the present invention under the 35 U.S.C. § 103.

In view of the present amendment to the claims and the above comments, it is believed that the case is now in condition for allowance, and an early notification of the same is requested. If the Examiner believes that a telephone interview will help further the prosecution of this case, he is respectfully requested to contact the undersigned attorney at the listed telephone number.

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on February 2, 2004.

By: James Lee

Signature

Dated: February 2, 2004

Very truly yours,

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